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ABSTRACT

Basic concepts of computer literacy are discussed as they relate to industrial arts/technology education. Computer hardware development is briefly examined, and major software categories are defined, including database management, computer graphics, spreadsheet programs, telecommunications and networking, word processing, and computer assisted and managed instruction. A list of applications is offered to identify the potential for incorporating the microcomputer in industrial arts/technology education. Examples suggest ways to use computers to account, budget, compute, communicate, control, design, file, grade, instruct, promote, purchase, problem solve, record, report, research, and test. Also provided is a list of the titles of the commercial microcomputer software for the Apple II compatible computer that is being used to implement microcomputer use in the Department of Industrial Technology at Purdue University, and Purdue's Technology Education Software Bank is described. Five references are listed. (LMM)

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Introduction

Few technological advances since the invention of the cathode ray tube and television have had as much potential impact on society as today's microprocessor technology and the microcomputer. Electronic miniaturization technology has made possible the development of small, affordable, and reliable computers for the home, school, and small business environments. Today, microcomputers small enough to fit on a desk top approach the data processing power of room size systems available just two decades ago.

Evidence of significant interest in the use of the developing personal computer technology is all around us. Science magazines have published articles on microelectronics for some time. Popular leisure-time magazines now regularly feature articles on electronic games, word processing, finance management, and other microcomputer applications. A new wave of magazines devoted to personal computing applications have appeared over the past few years. Clubs and special interest groups have formed to promote personal computing. Microcomputer user groups created to help individuals share experiences are common in cities across North America. Educational television now broadcasts programs on personal computing geared to improve technical literacy, raise consumer knowledge, and promote worthy use of leisure time.

The new technology that created microprocessors and personal computers offers educators many opportunities and challenges. According to Frederick (1980):

> "Education is privileged to be a witness to a revolution more far-reaching than that of the 'printing press,' and not just a witness, but

> potentially an integral part of the revolution. This revolution is the result of using microminiaturization techniques to produce general purpose computers affordable by many in our society. (p. 1)"

Evidence of the increased availability of microcomputers in the schools is being reported in the literature. According to a recent phone survey of 15,275 U.S. school districts conducted by Market Data Retrieval of Westport, CT, 55,765 public schools now use computers in instruction. There were approximately 325,000 microcomputers in U.S. public schools as of summer 1983. The research also indicated that the number of schools using computers in instruction doubled from 1982 to 1983 (**The Computer Teacher**, 1983, p. 8). It appears that schools throughout the nation are increasing computer instruction at all grade levels.

The inclusion of microprocessor technology and microcomputers in industrial arts/technology education (secondary level and teacher education) instruction has become necessary due to the expanding application of this technology in business, industry, education, and the home. As we enter the latter stages of the postindustrial society, such topics as automation, robotics, computer literacy, and information management become increasingly important curriculum concerns within industrial arts/technology education.

Implementation of these curriculum concerns will require microcomputer applications as **subject matter** in courses related to at least such areas as electronics, communication systems, computer-aided design/manufacturing, and other laboratory areas appropriate for this developing technology. Industrial arts/technology education personnel should also make use of this microcomputer technology as a motivational **instructional technology** tool including such applications

as computer simulations/games, computer assisted/managed instruction, word processing, laboratory management, record keeping, and other ancillary activities. The appliance computer is as important in today's industrial arts curriculum as the engine lathe, offset lithography press, drafting machine, oscilloscope, video tape player, textbook, and other instructional hardware and software. The array of potential industrial arts applications of the microcomputer is limited only by our lack of experience with this new technology.

The objective of the remainder of this presentation is to contribute to the needed computer literacy in industrial arts/technology education. The presentation will identify what computer hardware and software are and what major computer applications are available for industrial arts related applications.

Computer Hardware Development

Computers in the late 1940's were massive, unreliable, and expensive. For example, ENIAC (Electronic Numerical Integrator and Computer), the first electronic computer, weighed 30 tons, contained 18,000 vacuum tubes, and occupied a 30 by 50 foot floor space. The machine was programmed by wiring up to 6,000 switches. According to one source, one of ENIAC's vacuum tubes could fail every 15 minutes.

The computers developed in the early 1950's started to use a stored program concept. Here the wiring of switches to direct the machine was replaced by the ability of the computer to read and store its instructions. By the late 1950's and early 1960's, computers became smaller and more reliable due to the application of transistor technology. However, although computers were getting less expensive than the earlier machines, few systems existed outside of large

businesses and universities due to the high cost of equipment.

In the early 1970's silicon chip and manufacturing technology started to solve the cost problem. Intel's introduction of the microprocessor chip and the mass production of microelectronic components helped to reduce the price of computers. This technology made possible inexpensive computers small enough to fit on a desk top but as powerful as their bigger brothers of a decade earlier.

The primary hardware components of today's personal computer system include the microprocessor chip, internal memory, and power supply. Peripheral input/output devices such as alphanumeric keyboard, CRT display, and mass memory devices can be built into one identifiable case (as in the appliance computer), or can be connected to the computers as individual modules. Today's microcomputers are becoming more affordable for personal use in the home, school, and small business settings. Such machines are extending the computer revolution to individuals.

Major Software Categories

Computer equipment is useless without the instructions (software) that direct the machine in what is to be done. Many programming languages have been developed for communicating with computers. Machine language programs require a programmer to write instructions using numbers, letters, and special characters which have special meaning to the computer's electronic circuits. Higher level programming languages such as FORTRAN (FORmula TRANslation) and BASIC (Beginner's All-purpose Symbolic Instruction Code) communicate instructions to the computer using English-like words. Today there are several hundred different languages available for programming

computers.

Not all people are interested in the detail needed in developing computer programs. Many users desire the potential efficiency the computer offers without the need to become programming experts. Over the past several years a variety of preprogrammed (canned) applications software have been developed for the personal computer. The following software categories should be of value in the home, school, and small business environments.

Data Base Management. A data base can be thought of as an organized mass of data that allows for efficient information storage and retrieval. If you have used a file cabinet with dividers for major headings and file folders of information, you have used a type of data base. A computer data base program allows you to structure your file cabinet of information into subheadings and several levels of sub-subheading. The computer data base program then allows you to store and retrieve information from the "electronic file cabinet." The job of keeping track of the organized information, making information changes, and accessing certain categories of information becomes more efficient. Once information is organized into such data bases, information can be retrieved by conducting searches using names, key words, or other identifiers. Data base management programs commonly allow the user to sort, analyze, print, and plot output from the information stored in the data base.

Graphics. Computer graphics are the applications of the computer to produce animation, charts, designs, drawings, and pictures. The computer user can generate such graphics by using programs,

digitizers, light pens, and other input devices. Graphics can then be displayed using monochrome and color monitors, printers, plotters, and other output devices. There are numerous applications of computer graphics in personal computing. A good selection of inexpensive commercial hardware and software is available to support microcomputer graphics.

CAD (Computer-Aided Design) is a special application of computer graphics used not only to create a design graphic but also to facilitate design analyses. Several manufacturers package the software and hardware needed to use microcomputers as limited CAD systems.

Spreadsheets. A spreadsheet program can be thought of as a piece of electronic paper with columns and rows having a built-in calculator. At each column/row intersection you can enter names, numbers, or formulas. Automatic calculations can be made using the data in the columns and rows. Spreadsheet programs are great "what if" tools because of their quick editing and automatic calculating features. There are many applications for such electronic spreadsheets in industrial arts. Several books are available to help individuals use commercial spreadsheet programs.

Telecommunications and Networking. The resources available to the users of personal computers can be greatly expanded by the technology of telecommunications and networking. In general, telecommunications refers to the transmission of information through cables, phone lines, radio waves, and other carriers. A network can be thought of as a series of interconnected computers, terminals, or other hardware.

Two computers can be made to communicate with each other by equipping each machine with a MODEM (MOdulator-DEModulator). The modem converts the digital signals of the microcomputer into analog signals needed for telecommunications transmission. In order to cause two computers equipped with modems to communicate effectively, a terminal or communications program is needed. A number of commercial terminal programs allow computer bulletin board access, electronic mail, and multiuser networking.

The use of such telecommunications equipment can allow your personal computer to communicate with other computers. With telecommunications and networking capability, you can gain access to commercial data bases through services such as Compuserve, the Source, Dow Jones News/Retrieval, and Dialog Information Retrieval Service.

Word Processing. Word processing is a general term used to identify activities in which computers are used to write and alter documents. The typical microcomputer set-up for word processing includes the personal computer with typewriter-like keyboard, monitor, disk drive, printer, and word processing software. The use of a word processor allows quick and efficient writing, editing, revising, and printing of correspondence. Reports, manuscripts, records, and other documents needed in a small business, school, or home situation can be produced with the aid of a word processor. Several word processing programs have utility programs available to help the writer check spelling of word processed documents.

Computer Assisted/Managed Instruction. Computer assisted instruction (CAI) and computer managed instruction (CMI) are important

microcomputer software categories for education and training. Computer assisted instruction is a generic term covering all uses of the computer for actual instruction. Tutorial CAI is characterized by the computer's serving as a presenter of new information using a linear, branching, or dialog approach. Drill and practice CAI provides opportunity for students to use information previously obtained, much as flash cards are used. Simulation/game CAI not only allow students to use information previously learned, but can also be used to implement discovery learning. Computer managed instruction is the generic term covering uses of the computer for prescribing, supervising, and evaluating instruction.

Software for implementing CAI/CMI can be written in machine language, a higher-level language (such as BASIC and Pascal), or by using an authoring system (such as PILOT). Increasing selections of commercial and public domain software are becoming available for using CAI/CMI in industrial arts/technology education.

Applications

The number of specific individual applications of the personal computer in industrial arts/technology education is limited only by our inexperience with using this technology. The following list of applications is offered to identify the potential for incorporating microcomputers in the industrial arts/technology education.

Accounting. Manage the business transactions of an enterprise class using a general ledger, accounts receivable, accounts payable, or home accounting program.

Budgeting. Test the effect of proposed changes in a class or department budget using a spreadsheet program.

Computing. Perform mathematical operations needed in a power and energy class using a student developed BASIC program.

Communicating. Place public relations information concerning industrial arts programs on local computer bulletin boards. Send electronic mail to industrial arts student clubs at other school locations.

Controlling. Use a spreadsheet program to organize inventory data. Interface a microcomputer with an RS-232 serial port to a pick-and-place robot on a production simulation.

Designing. Produce graphic representations of products using a microcomputer equipped with a digitizing tablet or other computer aided design input hardware. Produce hard copy of designs with a printer, plotter, or photographic camera.

Filing. Store machine maintenance records for industrial arts laboratory using a data base program. Coordinate student attendance and safety instruction record keeping.

Grading. Use a spreadsheet program to manage student grades for an industrial arts class.

Instructing. Use a computer based instructional unit to teach energy conservation.

Promoting. Produce individualized form letters for an industrial arts PR campaign using a word processing program with a mailmerge feature. Prepare letters with a letter quality printer.

Purchasing. Use a data base program to computerize information on venders and suppliers of common items used in an industrial arts program. Word process vendor correspondence.

Problem Solving. Use a commercial simulation/game to facilitate student learning on the synthesis level.

Recording. Keep track of individual student work time during a production activity using a spreadsheet program. Use a student developed program to record inventory levels.

Reporting. Produce text of a student publication using a word processing program. Check spelling in a document with a dictonary program. Create charts and other needed visuals with graph-making software.

Researching. Using a microcomputer equipped with a modem and terminal program, access a commercial data base or information storage and retrieval system to acquire information needed to complete a student technical report.

Testing. Make the calculations needed to study a manufacturing material's mechanical properties using a student developed BASIC program. Use an educational utility program to generate a test for a unit of instruction.

Microcomputer Software Used at Purdue

Today many different microcomputer systems are available for use in the home, school, and small business setting. These systems range in price from a few hundred dollars to several thousand dollars. Most microcomputer authorities suggest that you first identify your application and software needs before trying to identify what particular computer system to purchase.

The Department of Industrial Technology at Purdue University has established a Technology Education Software Bank operated in cooperation with the American Industrial Arts Association. The Bank currently includes over 70 disks, each containing between 10 and 30 noncommercial, teacher-developed, or public domain general application, educational, and utility programs for the APPLE II computer. Individuals can obtain disks from this library on a swap or cost-recovery basis.

The Research Committee of the AIAA has compiled and edited a publication containing 33 microcomputer programs in various areas of industrial arts (Sarapin & Post, 1984). **The Iowa Handbook of Basic Programs for Industrial Arts** (Bro, 1980) is another microcomputer software resource. LaPorte (1983) compiled a bibliography of articles in the industrial arts literature containing computer program listings.

The selection of microcomputer software developed exclusively for industrial arts/technology education is still quite limited. However, the selection of applications software that can be used in industrial arts instruction is increasing. The following list represents the commercial microcomputer software for the APPLE II compatible computer

that is being used to implement microcomputer use in the Department of Industrial Technology at Purdue University.

ALF
Total Accuracy: Disk back-up utility

Apple Computer
Graphics Tablet & software
Shell Games: CMI utility
Super Pilot: Authoring system
Super Co-pilot: Utility for SP

Beagle Brothers
Alpha Plot: High-res graphics/text utility
Apple Mechanic: Typed & program controlled shape-fonts and a byte zap utility
Dos Boss: Disk command editor
Frame-Up: Apple slide projector
Tip disk 1
Type faces for apple mechanic
Utility City

Broderbond
The Bankstreet Writer: Word processor

Contintental Software
The Home Accountant

Gibson Laboratories
The Gibson Light Pen System

Koala Technology
Koala pad & software:a Touch activated graphics tablet

L & S Software
Crossword Magic 2: Word game utility

Milwaukee Area Technical College
MATC-CAD: Drafting Package

Micropro International
Wordstar: Word processor
Mailmerge: Merge utility for WS

Minnesota Educational Computing Consortium
Heatloss: Computer instructional unit

Muse
Three Mile Island: Simulation/game

Omega Microware
Locksmith 4.1: Disk back-up utility

Penguin Software

Complete Graphics System: Graphics utility
Additional fonts & character sets for CGS

Phoenix Software
Zoom Grafix: High-res graphics printing utility

Sensible Software
Multi Disc Catalog: Disk library utility

Sierra On-Line
Screenwriter II: Word processor
HomeWord: Word processor

Software Publishing Company
PFS: File (Data base filer)
PFS: Report (Data base utility)
PFS: Graph (Data base utility)
PFS: Write (Word processor)

SSM (Transend)
Transend II: Modem terminal program

Stoneware
Graphics Processing System: Graphics utility

Strategic Simulations
Cartels & Cutthroats: Business cycle simulation/game

Sun Microsystems
The Bridge: Utility for Visicalc, DOS text, and PFS files

Sunburst Communications
The Factory: Explorations in problem solving

The Learning Company
Rocky's Boots: Digital logic simulation/game

Versa Computing
Versawriter graphics tablet & standard software
VW Expansion PAC 1 and 2

Visicorp
Visicalc: Electronic spreadsheet

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Note

Several of the commercial software titles listed above were purchased to support technology education preservice and inservice instruction through a grant from The Technical Foundation of America.